Original

Outcomes of the mitrofanoff technique in the management of patients with neurogenic bladder: the experience in the san vicente de paúl university hospital

María E. Arango Rave*, Luis F. Lince Varela*, Catalina Salazar Sanín, Francisco C. Hoyos Figueroa* Sara N. Hurtado*, Juan C. Rendón Isaza****

**Departamento de Cirugía Pediátrica. **Cirugía General. Universidad de Antioquia. Colombia*

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Abstract

Introduction: The care of children with neurogenic bladder should be integral and multidisciplinary, seeking to preserve renal function and achieve urinary and fecal continence so that the patient can be self-sufficient and useful to society.

Methods: The outcome of use of the Mitrofanoff technique for the treatment of patients with neurogenic bladder dysfunction in the HUSVP from 1998-2003, and the current condition of the patients with regard to their illness and treatment are described in this article. A descriptive retrospective study from 1998-2002 and a prospective study during 2003 were done, in which a series of cases were analyzed.

Results: 41 patients had surgery. Average age 10.2 years; average follow-up time 27.2 months; the most frequent disease was myelomeningocele (46.3%) and 46.3% had dyssynergic bladder. Bladder augmentation was performed in 63.3%, of which 71.4% were constructed with ileum. A surgical intervention of the bladder neck was done on 51.2%.

A continent conduit (Mitrofanoff) was performed in 95.1% of the patients with complete continence 70.4%, complete incontinence 14.6% and occasional incontinence 14.6%. 31.7% had Malone surgery with adequate fecal management in 90.2%. 19% of the stomas had stenosis and 21.9% had urine leakage. 80% achieved adequate social adaptation.

Conclusions: Continent catheterizable stomas are useful for the treatment of urinary and fecal incontinence. Conduits constructed with ileum had more complications than conduits constructed with cecal appendix, which is why the appendix is the tissue of choice to perform continent catheterizable stomas, when available.

Key Words: Neurogenic Bladder, Mitrofanoff, Continent Catheterizable Stoma, Urinary Incontinence.

INTRODUCTION

Lower urinary tract function depends on neuromuscular coordination of the bladder, the urethra, and the striated muscle responsible for the sphincter mechanism. A neurological or muscular disorder in these structures leads to urinary dysfunction[1].

Neurogenic bladder, which is caused by a disorder of neurological control of continence and urination, includes all problems of urination whose origin is in the central nervous system. The leading cause of neurogenic bladder dysfunction in children is spina bifida occulta or spinal dysraphism; however, it may also be caused by sacral agenesis, tumors, inflammatory diseases affecting the spinal cord or by spinal cord trauma. It is essential to carry out urodynamic and imaging studies to determine both upper and lower urinary tract function in order to establish a treatment plan for each patient[1,2], followed by appropriate follow-up[3]. Urodynamic findings in neurogenic bladder basically determine if the bladder can be classified as synergic, dyssynergic, or nonfunctional.

The management of children with neurogenic bladder should be integral, multidisciplinary and have three key objectives: preserve renal function, seek urinary and fecal continence, and enable the patient to be a self-sufficient person and useful to society.

Treatment seeks to achieve urinary continence in the patient and to protect the upper urinary tract from the progressive alterations that occur as a result of the increased pressures in the lower urinary tract. Achieving this requires interventions aimed at converting a low capacity and/or high pressure bladder into a reservoir with adequate capacity at low pressure, which allows easy and complete voiding, and a hypotonic sphincter into a competent mechanism that does not allow involuntary urine leakage. The capacity of spontaneous urination through the urethra should also be preserved, which is the most difficult task. Management of neurogenic bladder should start as soon as the diagnosis is made to prevent the progressive deterioration of the upper urinary tract. The early institution of clean intermittent catheterization[4], every three hours in the neonatal period, is safe and well tolerated, allows long-term management of neurogenic bladder and avoids the deterioration of the upper urinary tract, protecting the child until he or she is old enough to face a definitive surgical procedure, when this is necessary. The surgical procedures that are normally performed are: bladder augmentation[2,5], continent stomas among which are included the Mitrofanoff procedure[6-10] and the Monti tube[11,12], artificial sphincters[13], urethral sling[2,13], submucosal injection of the bladder neck[2,13], bladder neck reconstruction[2,13] and urethral cerclage[2]. Surgical treatment may be complemented with pharmacological therapy, which consists of the administration of anticholinergic drugs that cause detrusor relaxation[4].

Most patients with neurological diseases that cause neurogenic bladder also have disorders of colonic and anorectal function that cause fecal incontinence, which is why in some patients procedures are performed to allow the administration of antegrade enemas such as the Malone[14-21].

The main complication occurring with stomas is stenosis[7,19,22,23], which is why different techniques have been designed that use flaps to prevent it or correct it[24].

The outcome of the Mitrofanoff technique can be evaluated in terms of urinary continence, absence of stomal complications, surgical reoperations due to complications, and protection of the upper urinary tract. It can be generally stated that the outcomes in terms of continence are good, although a high frequency of surgical revision of the conduit due to leakage and stenosis was reported in the series with longer term follow-up[7,19,22-24].

Since 1998, the San Vicente de Paúl University Hospital (HUSVP) in Medellín, Colombia, has offered alternative surgical treatments to children with neurogenic bladder and colon.

The purpose of this research is to describe the type of treatment used over a period of 8 1/2 years in patients with neurogenic bladder attending the Pediatric Surgery Department of the HUSVP and the University of Antioquia, as well as their clinical course.

METHODS AND PATIENTS

A retrospective and prospective descriptive observational study was carried out, in which a series of cases were analyzed. The information was collected by an interview based on review of the medical histories, and completed by a telephone call to the patient or caregiver, at which the data about the patient's current condition was obtained.

The clinical records of all patients operated on for neurogenic bladder at the HUSVP who met the inclusion criteria were evaluated.

The questions from the telephone interview that evaluated the outcomes for urinary and fecal continence and social adaptation were recorded in the case report form and were the following:

20. Urinary continence:	1. Complete	2. Incomplete	
	3. Incontinent	4. NA	
21. Fecal continence:	1. Yes	2. No	3. NA
22. Stomal stenosis:	1. Yes	2. No	3. NA
23. Stomal fecal leakage:	1. Yes	2. No	3. NA
27. Acceptance of catheterization:	1. Yes	2. No	3. NA
28. Social adaptation:	1 Yes	2. No	3. NA

INCLUSION CRITERIA

All pediatric patients under 12 years of age who were surgically treated for neurogenic bladder at the HUSVP between January 1, 1998 and May 31, 2006, and whose clinical records were available.

DATA ANALYSIS PLAN

Data were analyzed with the SPSS 10 software. For the described analysis, qualitative variables were reported as proportions and quantitative variables as mean or median and measures of dispersion such as standard deviation and ranges. A univariate exploratory analysis was performed to compare the independent qualitative variables with the dependent variable using Fisher's exact test. The Mann-Whitney U test was used for comparison of qualitative variables.

RESULTS

Adequate clinical records were obtained in a total of 41 patients, of which 23 were male and 18 were female; there was no relationship between sex and underlying disease. Average age at surgery was 10.2 years (range 1 – 20 years).

Average follow-up time was 27.2 months (range 1 – 72 months). The most frequent underlying disease was myelomeningocele in 19 patients (46.3%), followed by other spinal malformations in 5 patients (12.2%), and posterior urethral valves in 5 patients (12.2%). See Table 1.

Table 1

Underlyng diseases

Underlying disease	number of patients (%)
Myelomeningocele	19 (46.3)
Spinal cord trauma	1 (2.4)
Congenital malformations*	4 (9.8)
Posterior urethral valves	5 (12.2)
Ochoa syndrome	4 (9.8)
Other**	8 (19.5)

*Congenital malformations include: bladder exstrophy (2 patients), short megaurethra (1 patient), urethral agenesis (1 patient).

**Others: spinal malformations (5 patients), primary neurogenic bladder (1 patient), urethral trauma (1 patient) and neuroblastoma (1 patient).

The average value of creatinine was 0.8 mg/dL (range 0.2 – 2.7 mg/dL); the highest values were found in patients with a previous diagnosis of posterior urethral valves.

The urodynamic studies revealed that 19 patients (46.3%) had a hypertonic bladder, of which 10 had myelomeningocele and 2 another spinal malformation; 13 patients (31.7%) had a nonfunctional bladder, and only 3 (7.3%) had a normal bladder; this data was not obtained in 6 patients. Regarding the sphincter, 17 patients had a nonfunctional sphincter (41.5%), of which 13 had a diagnosis of myelomeningocele; this data was not obtained in 6 patients. In 14 patients, detrusor-sphincter dyssynergia was also found.

Eighty-five percent of patients had one or more episodes of urinary infection before surgery. None of the underlying conditions was related with a higher frequency of urinary infection.

Structural abnormalities of the urinary tract were present in 20 patients (48.8%). There was no relationship between structural abnormalities of the urinary tract and underlying disease.

Bladder augmentation was performed in 28 patients (68.3%) with low capacity bladders, of which 15 had a diagnosis of myelomeningocele; 4 had posterior urethral valves; 3 had a urofacial syndrome,

and 4 had other congenital malformations. The tissue used for bladder augmentation was ileum in 20 patients (71.4%), ureter was used in 7 (25%) and colon in 1 (3.6%). There was no relationship between the type of tissue used and the underlying disease. Figure 1.

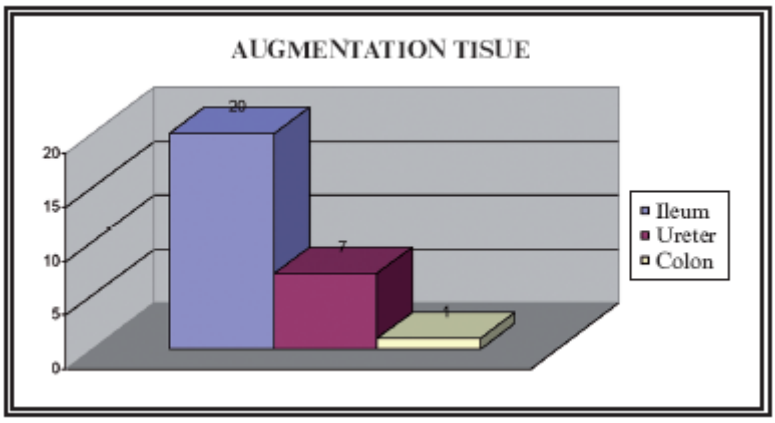

FIGURE 1. Tissue used in bladder augmentation.

In 21 patients (51.2%), bladder neck procedures were performed, such as urethral sling, bladder neck cerclage or lengthening. No artificial sphincter was used. Fourteen (66.6%) of these patients had a diagnosis of myelomeningocele.

A Mitrofanoff continent catheterizable vesicocutaneous conduit was constructed in 39 patients (95.1%); the tissue used in 25 of the 39 patients (64.1%) was appendix, followed by ileum (Monti tube) in 10 and ureter in 4 patients. The choice of the tissue to be used was made based on the presence or not of the cecal appendix, or because the appendix was used for construction of a conduit that would allow the administration of antegrade enemas (Malone surgery). For this reason, most of the Mitrofanoff urinary diversions constructed with ileum (Monti tube) were done in children with a diagnosis of myelomeningocele (8 of 10).

The Malone procedure was performed in 13 patients (31.7%) using cecal appendix in 12 and a cecal flap in 1. Of these patients, 9 had a diagnosis of myelomeningocele, 3 of spinal malformations and 1 of spinal cord trauma. The average follow-up time of these patients was 28.4 months.

Urinary continence both for the Mitrofanoff catheterizable conduit and the urethra was defined as complete in 29 patients (70.8%); incomplete, or with occasional urine leakage, in 6 patients (14.6%), and incontinent in 6 patients (14.6%). Figure 2. The average follow-up time was 24.6 months in patients with complete continence, 34.2 months in patients with incomplete continence and 32.6 months in patients with incontinence. The degree of continence was not related with the age at which initial surgery was performed.

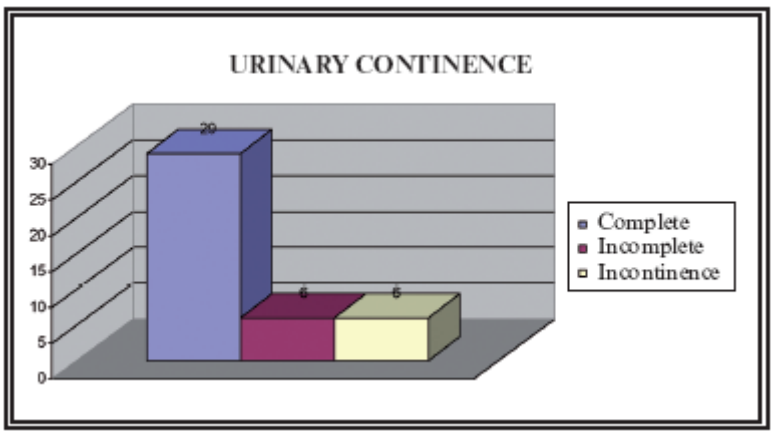

FIGURE 2. Outcomes in urinary continence.

When the relationship between the type of tissue used for construction of the catheterizable conduit and urinary continence was analyzed, it was found that complete urinary continence was achieved in 20 of the patients (80%) in which appendix was used, in 5 (50%) in which ileum was used, and in 3 (75%) in which ureter was used. Stenosis of the catheterizable conduit stoma occurred in 8 patients; 3 (12%) of the stomas constructed with appendix, 3 (30%) with ileum, and 2 (50%) with ureter. The average follow-up time of the patients who had stomal stenosis was 38.7 months. Similarly, 9 patients had urine leakage through the catheterizable conduit, 4 (16%) of which were made with appendix, 4 (40%) with ileum, and 1 (25%) with ureter.

Of the 41 patients, 37 (90.2%) had adequate fecal continence, the 4 remaining patients had a diagnosis of myelomeningocele; only 1 of the 13 patients in whom the Malone procedure was performed did not achieve good fecal management. The average follow-up time was 25.5 months in patients who did not achieve fecal continence and 27.3 months in those who did. None of the patients had fecal leakage through the stoma. Only one patient had stenosis of the Malone stoma because the patient refused to be catheterized to administer the antegrade enemas.

Forty-six additional procedures were performed in 18 patients (44%); 1 patient had 15 procedures. Stoma revision was required in 16 patients, bladder revision in 2 patients and bladder neck procedures in 4 patients. The causes of these interventions were meatal stenosis (9), urine leakage (9), urethral incontinence (2), conduit necrosis (1), graft loss (1), conduit obstruction (1) and mucosal prolapse (1). One patient in whom the Malone procedure was performed using appendix required an additional procedure because of stoma stenosis. Fifty percent of the patients who required additional procedures had a diagnosis of myelomeningocele.

Forty patients currently perform intermittent bladder catheterization via the urethra or the Mitrofanoff catheterizable conduit and one patient refuses catheterizations. Of the 40 patients, 36 (87.8%) were able to self-catheterize adequately and 4 had complications for catheterization (one had urinary incontinence through the Mitrofanoff and the urethra, one had moderate loss of urine through the Mitrofanoff, and the other two were incontinent). There was not relationship between follow-up time, bladder type, tissue used for the Mitrofanoff conduit or age at surgery and acceptance of catheterization.

Thirty-three of the patients (80%) have achieved adequate social adaptation in terms of interaction with their environment and schooling. Of these, 26 are dry between catheterizations (25 via the Mitrofanoff and 1 via the urethra), 5 have some degree of incontinence via the urethra or the Mitrofanoff, and the two remaining patients are incontinent via the urethra.

One-hundred percent of the patients with posterior urethral valves or urofacial syndrome have adequate social activity, while 49% of the patients with neurogenic bladder secondary to neural tube defects have some difficulty related to schooling or social adaptation.

DISCUSSION

Successful treatment of urinary and fecal incontinence in children with neuropathic disorders can improve their quality of life and allow their socialization and well-being. The development of the technique for construction of a catheterizable vesicocutaneous conduit described by Mitrofanoff has been the major contribution to achieving adequate control of urinary continence[25] and it has been especially important in patients with low socioeconomic and educational levels[34]. Since this principle was first described, the appendix has been the tissue of choice for conduit construction. However, in some cases the appendix is not available or is needed for other purposes, such as construction of the Malone conduit. Yang in 1993 and Monti in 1997[11,15] developed an alternative technique to create a catheterizable vesicocutaneous conduit from a segment of intestine, which became the best option for its construction with a tissue other than the appendix. This procedure is simple, cause little loss of intestine and can be combined with bladder augmentation using part of the same bowel segment isolated[27].

The primary objective of this study was to evaluate the outcome of surgical treatment of children diagnosed with neurogenic bladder, associated or not with neurogenic colon, comparing over a period of 8 1/2 years the different surgical options and tissues used.

In this study, as in the literature reviews[33], myelomeningocele was the most frequent disease requiring this type of surgical reconstruction (46.3%), following by other spinal malformations (12.2%), congenital malformations (9.8%), posterior urethral valves (12.2%) and urofacial syndrome (9.8%). Castellan et al.[25] showed in a study of 135 patients with 10 years of follow-up that the main disease warranting this type of surgery was myelodysplasia in 71% of the cases, followed by congenital malformations in 17%.

It was found that 56.1% of patients were male. The average age at which the surgical procedure was performed was 10.2 years (range 1 – 20 years), similar to that reported by other authors, except for Castellan et al.[25] who reported an average of 13 years.

The series with the longest follow-up was reported by Liard et al.[23], with an average of 20 years (range 15 – 23 years); Castellan et al.[25] showed an average follow-up of 46 months for the Mitrofanoff; Wedderburn et al.[19] reported in a series of 46 patients an average follow-up of 44 months; our average follow-up was 27.2 months (range 1 – 72 months), which makes it valuable in the evaluation of long-term outcomes.

The study of Liard et al.[23] reported complications such as deterioration of renal function in 10 patients that required performing other diversion procedures. Vesicoureteral reflux was found in 5 patients, bladder stones in 5 patients, and intestinal obstruction in 5 other patients. In our study, 4 patients had stone formation and none had deterioration of renal function after surgery.

We found that 85% of the children had urinary infection prior to the surgical procedure. Urinary tract infection recurred in 75% after surgery, without any factor associated with this recurrence, although it was probably due to poor technique during intermittent catheterization.

Bladder augmentation was performed in 68.3% of the patients and the tissue used was ileum in 71.4%, ureter in 25% and colon in 3.6%, similar to the percentages reported in the literature.

A surgical option that improves bladder neck continence in up to 75% of cases is the construction of a urethral sling; the overall frequency of this technique was around 15% and it has been reported to provide long-term continence rates between 69% to 85%[13]. In our institution, bladder neck procedures were performed in 21 patients (51.2%), most with a diagnosis of myelomeningocele and other spinal malformations. This procedures required revision in 4 patients (19%) and 2 patients with urethral slings had to be converted to bladder neck cerclage. At the time of collection of the information, only one patient with a bladder neck procedure had urethral incontinence. The above describes the results of bladder neck cerclage in our setting, which were similar to those reported in the literature. Artificial sphincter placement is not available in our institution, a method which has been reported worldwide to provide continence rates ranging from 80% to 100%[13].

Stenosis of the vesicocutaneous stoma is the most frequent complication. Reports of stomal complications with appendix vary between 19% and 26%[29,30]. In this study, stenosis of the catheterizable vesicocutaneous conduit was found in 12% of those constructed using appendix and in 30% of the those using ileum (Monti tube). Stenosis of the colocutaneus stoma (Malone) occurred in 8.3%. In addition, some type of procedure on the vesicocutaneous conduit was performed due to urinary incontinence in 8 patients (20%).

Of 13 patients in whom a Malone catheterizable colocutaneous conduit was performed, 12 achieved adequate fecal control with antegrade colonic irrigations. It should be clarified that the Malone procedure does not improve fecal continence, but rather allows the colon to be kept clean using enemas to facilitate fecal evacuation at the appropriate time and place, thereby improving social adaptation of the child; however, any disturbance in intestinal motility can alter this evacuation. The results obtained with the procedure were similar to those reported in the literature and are satisfactory for us.

We did not find any study reporting on patient acceptance of catheterization to allow comparisons to be made with this study. Our study found adequate acceptance of catheterization as most of the problems with clean intermittent catheterization were related to complications with the conduit and not to negligent behaviors by parents or children.

Tekant et al.[31] used the Rosenberg self-esteem scale after performing surgery in their patients, and though they do not report the exact percentage of improvement, they found a significant increase in self-esteem and a decrease in the frequency of depressive symptoms in their patients. In our study, we attempted to assess how well children were adapted in terms of socialization and schooling according to their age and mental condition. Adequate information was obtained in 35 children, of

which 33 engaged in normal school and social activities. Only two children did not attend school or engage in activities involving social interaction and of these one had urinary incontinence and poor fecal control (the child in whom more additional procedures were performed). Of the children with adequate schooling and social interaction, two had frank urinary incontinence and 5 had partial urinary incontinence.

Although the design of the study was descriptive, it suggests a certain tendency for a relationship to exist between the outcome in terms of continence and the development process of the child. Thus, we see that our patients improve significantly in their social process when they achieve continence and have better access to educational processes because they no longer suffer the urinary and fecal accidents that make them feel ashamed in front of the other children.

The choice of the type of conduit to be used depends on various factors including its availability, the type of surgery and the underlying diagnosis[32]. We concluded that the appendix is the tissue of choice whenever it can be used, because it offers technical advantages and has superior outcomes over other tissues. The use of the Monti tube should be dependent on the availability of the appendix, as indicated in the study by Leslie et al., where they describe a predictable, reproducible and durable method for creating a continent channel[32]. An alternative is construction of a Malone conduit using a cecal flap, which would allow construction of a Mitrofanoff stoma using appendix in most cases.

Surgical management of the neurogenic bladder can prevent renal damage and in our case bladder augmentation had low morbidity[33]; furthermore, it has advantages in terms of continence, comfort and quality of life for the patients. We consider that the disease that carries the highest risk for morbidity of the procedure and the long-term prognosis of the child is neurogenic bladder of spinal cord origin, since these defects are the ones most often associated with other pathological conditions and physical limitations.

The management of neurogenic bladder requires a complete assessment of the patient's condition, underlying diagnosis and associated diseases. Continent catheterizable stomas are feasible and technically safe methods for the treatment of urinary and fecal incontinence[34]. No significant differences were found in terms of long-term outcomes between the use of the different tissues for construction of the vesicocutaneous conduit, but it was found that the stomas constructed with a tubularized bowel segment had more complications than those constructed with appendix, which is why the appendix should be the tissue of choice, when available.

In general, the outcomes in urinary continence, fecal continence and improvement of quality of life in children with neuropathic bladder are significantly better than those in children with neurogenic bladder secondary to spina bifida or spinal cord trauma.

REFERENCES

1. Schulman SL, Duckett JW. Disorders of bladder function. O'Neill JA, Rowe MI, Grosfeld JL, Fonkalsrud EW, Coran AG, editors. Pediatric surgery, fifth edition, Mosby 1998.

2. Sheldon CA, Snyder HM. Structural disorders of the bladder, augmentation. O'Neill JA, Rowe MI, Grosfeld JL, Fonkalsrud EW, Coran AG, editors. Pediatric surgery, fifth edition, Mosby 1998.

3. Madersbacher H. Neurogenic bladder dysfunction in patients with myelomeningocele. Curr Opin Urol. 2002;12(6):469-472.

4. Aslan AR, Kogan BA. Conservative management in neurogenic bladder dysfunction. Curr Opin Urol. 2002;12(6):473-477.

5. Mills RD, Studer UE. Metabolic consequences of continent urinary diversion. J Urol. 1999;161(4):1057-1066.

6. Mitrofanoff P. Trans-appendicular continent cystostomy in the management of the neurogenic bladder. Chir Pediatr. 1980;21(4):297-305.

7. Cain MP, Casale AJ, King SJ, Rink RC. Apendicovesicostomy and new alternatives for the Mitrofanoff procedure: results in the last 100 patients at riley children's hospital. J Urol. 1999;162(5):1749-1752.

8. Gosalbez R, Wei D, Gousse A, Castellan M, Labbie A.. Refashioned short bowel segments for the construction of catheterizable channels (the Monti procedure): early clinical experience. J Urol. 1998;160(3 Pt 2):1099-1102.

9. Hanna MK, Richter F, Stock JA. Salvage continent vesicostomy after enterocystoplasty in the absence of appendix. J Urol. 1999;162(3 Pt 1):826-828.

10. Boemers TM. Mitrofanoff procedure with Meckel´s diverticulum. BJU International. 2001;88(7):799-800.

11. Monti PR, Lara RC, Dutra MA, de Carvalho JR. New techniques for construction of efferent conduits based on the Mitrofanoff principle. Urology. 1997;49(1):112-115.

12. Van Savage JG, Yepuri JN. Transverse retubularized sigmoidovesicostomy continent urinary diversion to the umbilicus. J Urol. 2001;166(2):644-647.

13. Kryger JV, González R, Barthold JS.. Surgical management of urinary incontinence in children with neurogenic sphincteric incompetence. J Urol. 2000;163(1):256-263.

14. Yang WH. Yang needle tunneling technique in creating antrireflux and continent mechanisms. J Urol. 1993;150(3):830-834.

15. Cromie WJ, Barada JH, Weingarten JL. Cecal tubularization: lengthening technique for creation of catheterizable conduit. Urology. 1991;37(1):41-42.

16. Adams MC, Bihrle R, Foster RS, Brito CG. Conversion of an ileal conduit to a continent catheterizable stoma. J Urol. 1992;147(1):126-128.

17. Figueroa TE, Sabogal L, Helal M, Lockhart JL. The tapered and reimplanted small bowel as a variation of the Mitrofanoff procedure: preliminary results. J Urol. 1994;152(1):73-75.

18. Malone PS, Ransley PG, Kiely EM. Preliminary report: the antegrade continence enema. Lancet. 1990;336(8725):1217-1218.

19. Wedderburn A, Lee RS, Denny A, Steinbrecher HA, Koyle MA, Malone PS. Synchronous bladder reconstruction and antegrade continence enema. J Urol. 2001;165(6 Pt 2):2392-2393.

20. Bau MO, Younes S, Aupy A, Bernuy M, Rouffet MJ, Yepremian D, et al. The Malone antegrade colonic enema isolated or associated with urological incontinence procedure: evaluation from patient point of view. J Urol. 2001;165(6 Pt 2):2399-2403.

21. Gerharz EW, et al. The in situ appendix in the Malone antegrade continence enema procedure for faecal incontinence. BJU. 79:985. 1997.

22. Harris CF, et al. Appendicovesicostomy: the Mitrofanoff procedure – A 15 year perspective. J Urol. 163:1922 – 1926. 2000.

23. Liard A, et al. The Mitrofanoff procedure: 20 years later. J Urol. 165:2394 – 2398. 2001.

24. Kajbafzadeh AM, Chuback N. Simultaneous Malone antegrade continent enema and Mitrofanoff principle using the divided appendix: report of a new technique for prevention of stoma complications. J Urol. 165:2404 - 2409. 2001.

25. Castellan MA, Gosalbez R, Labbie A, Ibrahim E, DiSandro M. Outcomes of continent catheterizable stomas for urinary and fecal incontinence: comparison among different tissue options. BJU International. 95:1053 - 1057. 2005.

26. Roberts JP, Moon S, Malone PS. Treatment of neuropathic urinary and faecal incontinence with synchronous bladder reconstruction and the antegrade continence enema procedure. BJU. 75:386 – 389. 1995.

27. Castellan MA, Gosalbez R, Labbie A, Monti PR. Clinical applications of the Monti procedures as a continent catheterizable stoma. Urology. 54:152 - 156. 1999.

28. De Ganck J, Evaraert K, Van Laecke E, Oosterlinck W, Hoebeke PA. A high easy to treat complications rate is a prize for a continent stoma. BJU International. 90:240 – 243. 2002.

29. Narayanaswamy B, Wilcox DT, Cuckow PM, Duffy PG, Ransley PG. The Yang-Monti ileovesicostomy: a problematic channel? BJU International. 87:861 - 865. 2001.

30. Clark T, Pope JC, Adams MC, Wells N, Brock JW. Factors that influence outcomes of the Mitrofanoff and Malone antegrade continence enema reconstructive procedure in children. J Urol. 168:1537 – 1540. 2002.

31. Tekant G, Emir H, Eroglu E, Esenturk N, Buyukunal C, Danismend N, Soylet Y. Catheterizable continent urinary diversion (Mitrofanoff principle) – clinical experience and psychological aspects. Eur J Pediatr Surg. 11(4):263 - 267. 2001.

32. Leslie JA, Dussinger AM, Meldrum KK. Creation of continence mechanisms (Mitrofanoff) without appendix: the Monti and spiral Monti procedures. Urol Oncol. 2007;25(2):148-153.

33. Proesmans W. The neurogenic bladder: introducing four contributions Pediatr Nephrol. 2008;23(4):537-540. Epub 2008.

34. Sultan S, Hussain I, Ahmed B, Aba Umer S, Saulat S, Naqvi SA, et al. Clean intermittent catheterization in children through a continent catheterizable channel: a developing country experience. J Urol. 2008;180(4 Suppl):1852-1855; discussion 1855. Epub 2008 Aug.

Correspondence author: Dra. María E. Arango Rave

Departamento de Cirugía Pediátrica

Universidad de Antioquía. Tel.: 2637867

Author e-mail: rafael195@une.net.co

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